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Timing the extragalactic X-ray binary population

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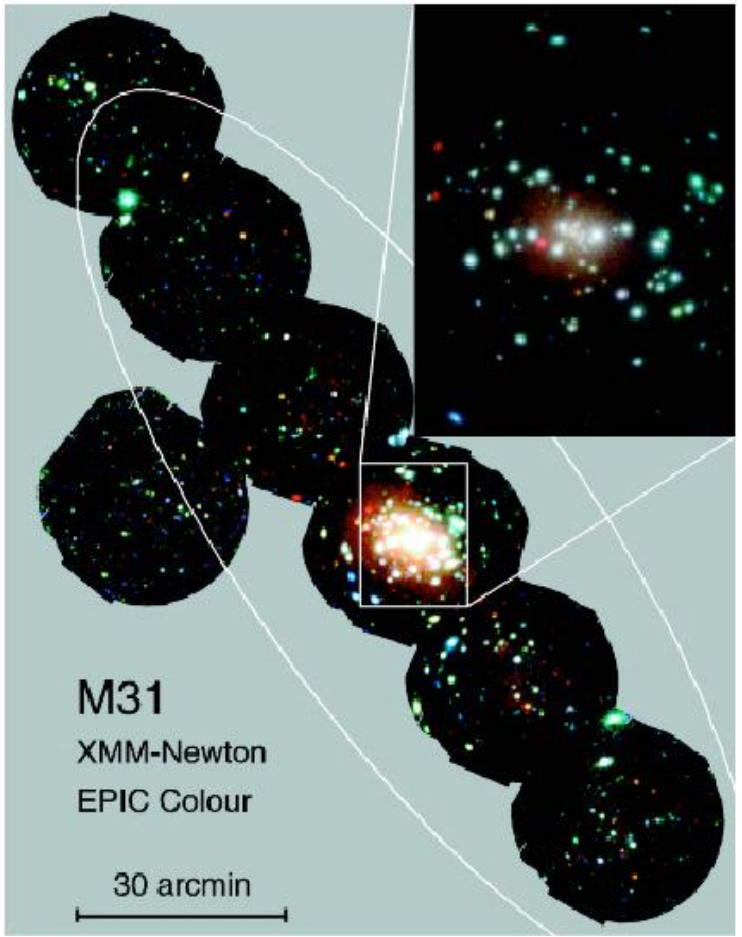
Outline for talk

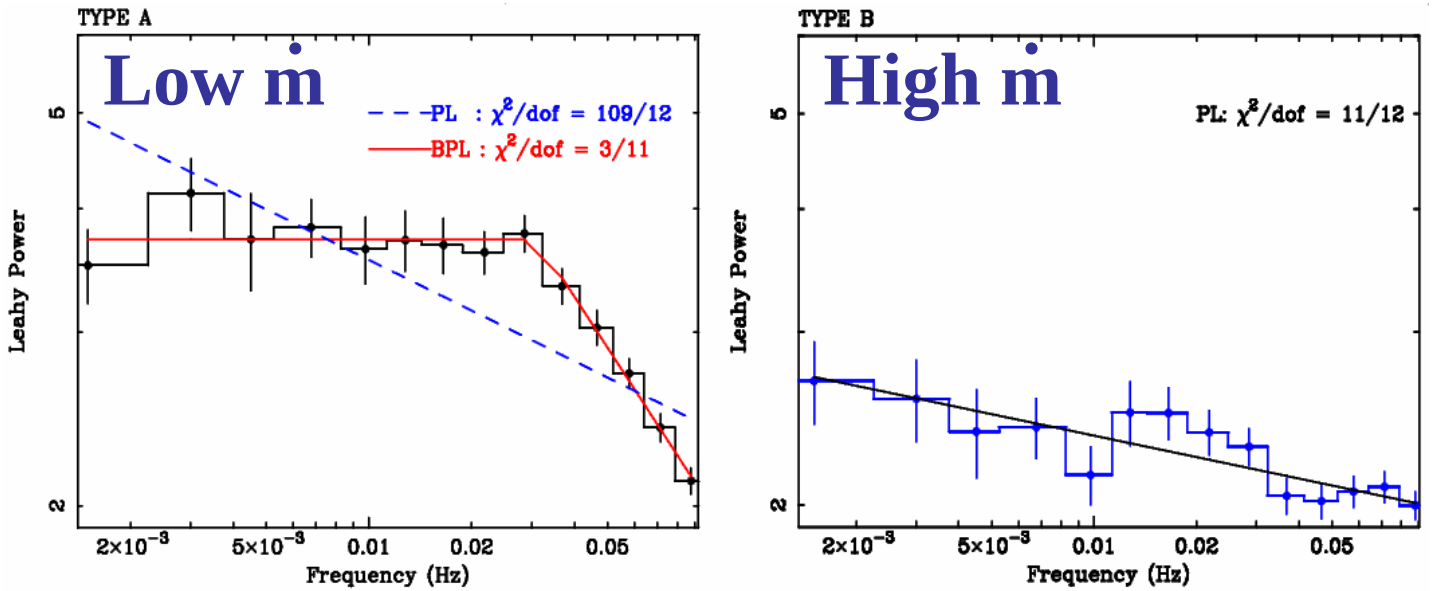
- Colour-Coulour surveys of extragalactic X-ray sources
- How can timing help?
- Our survey of Andromeda Galaxy (M31)
- Highlights from our results
- Conclusions and future work

Colour-Colour surveys of extragalactic X-ray sources

- Most X-ray surveys of other galaxies use only colours and long-term variation
- E.g. Pietsch et al. survey of M31:
  - Found 856 sources
  - 567 had colours of either X-ray binaries, AGN or Crab-like SNR



How can timing help?



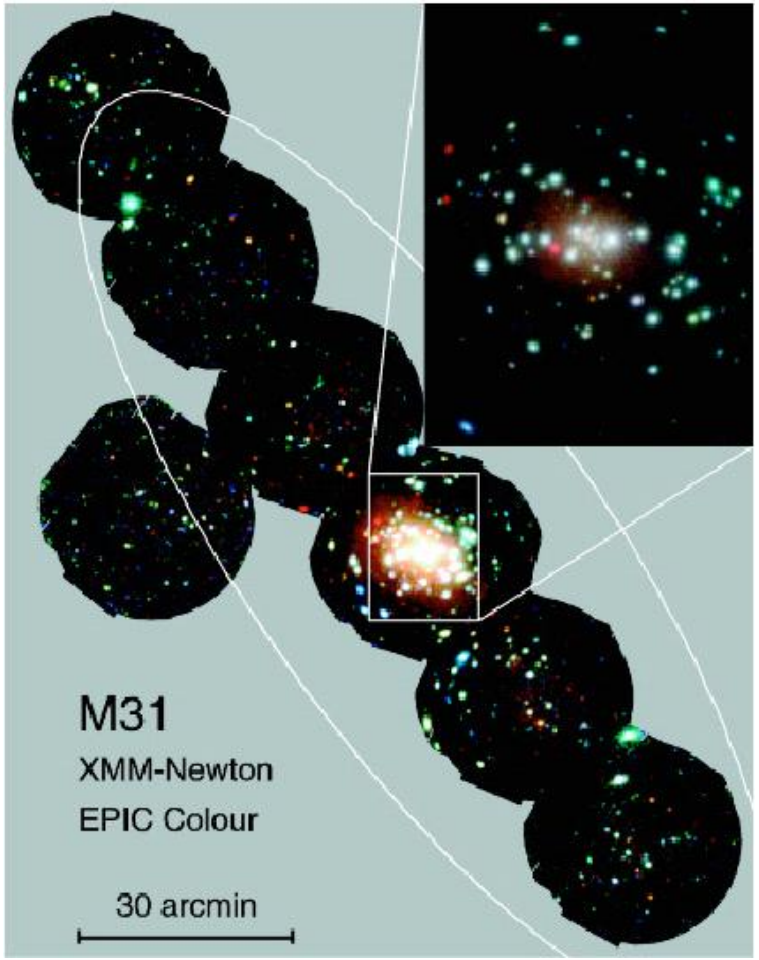
- LMXBs exhibit characteristic variability that depends more on accretion rate than primary (van der Klis 1994)
- Low accretion (Type A) PDS distinguishes X-ray binary from fg stars and bg AGN
- XMM-Newton first to see Type A outside MW and MCs

Our M31 survey

- Examined variability and 0.3-10 keV spectral energy distributions (SEDs) of point sources in M31
- For each source we made source and background extraction regions, giving
  - EPIC PN + MOS1 + MOS2 lightcurves at 2.6 s binning in 0.3-2.5, 2.5-10 and 0.3-10 keV bands
  - Source and background PDS in the 0.3-10 keV band
  - EPIC PN SEDs for the source and background
- We obtained 0.3-10 keV luminosities from best fit models to the SEDs

Result Highlights

- So far, looked at 352 sources in core and disc regions of M31
- 114 likely X-ray binaries,106 new IDs by us
- If Type A @ L > $4x10^{37}$ erg s^{-1} in 0.3-10 keV band, then black hole candidate (Barnard et al., 2003, 2004, 2006)
- We found 13 BHCs



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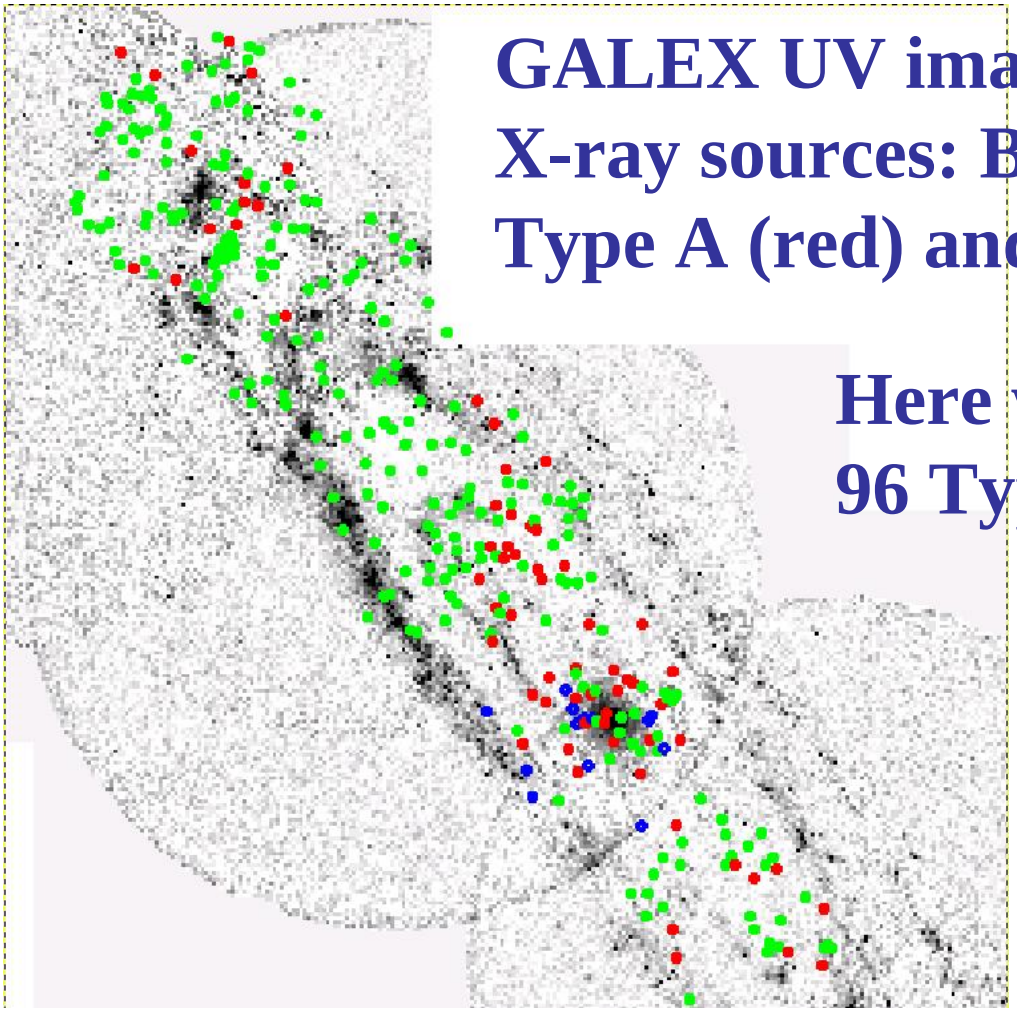
M31 in UV and X-ray



GALEX UV image of M31 superposed with X-ray sources: BH Type A (blue), other Type A (red) and no Type A (green)

Here we show 313 sources, with 96 Type A

Have examined 49 more in the core, and found 20 more Type A in last few days

Conclusions and future work

- XMM allows detailed timing analysis of extragalactic X-ray binaries for first time
- Timing can separate X-ray binaries from SNR, AGN and foreground stars cannot
- May also identify BH candidates in LMXBs (Barnard et al., 2006, A&A, in press, astro-ph/0508284v2)
- Long XMM observations of nearby galaxies should reveal many more X-ray binaries!